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(54) PROCESS OF GRINDING COFFEE BEANS

(71) We, GENERAL FOODS CORPORATION, a Corporation organized under the laws of the State of Delaware, United States of America, of 250 North Street, White Plains, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention pertains to an improved process for preparing roasted coffee in particulate form wherein it is suitable for use as regular roasted coffee for home brewing or for use in a commercial percolation process to produce soluble coffee.

The standard technique in use today to prepare roasted and ground coffee is to pass green coffee beans into a commercial roaster wherein the coffee is roasted to a predetermined roast color, the roasted coffee on discharge from the roaster is generally quenched with water and then air cooled. The cooled beans are then tempered (allowed to stand to insure uniform distribution of moisture) and ground in roll type grinders to obtain coffee particles with a desired size distribution. The roast color will be varied depending upon the types of green coffee used, the flavor characteristics to be developed and the intended use for the roasted coffee, e.g. as regular coffee or as percolator feed in a soluble scoffee system. Similarly, the moisture content and particle size will be varied depending upon the intended use for the roasted coffee.

Some prior art processes have subjected roasted coffee to pressure treatment in a press or in rolls for various reasons. Thus, processes have been described wherein coffee was crushed in a press to obtain coffee tablets or pellets. Also, coffee has been passed through rolls to degas and crack the coffee beans. Pressing of coffee beans has been reported as a means of increasing the available soluble solids in roasted coffee and as a means of producing a more compact coffee with less surface area for oxidative deterioration.

To date, grinding of roasted coffee beans has been considered a means of achieving a necessary subdivision of the beans. While particle size has been known to have an effect upon appearance and extraction rates, no other special significance is generally attributed to grinding.

It has now been discovered that if roasted coffee beans are subjected to compression flaking followed by a gentle granulation, unique physical and organoleptic properties can be developed. Also, the beverage prepared from coffee treated via the process of this invention is found to be of a superior quality.

Compression flaking is intended to describe the process step whereby the whole roasted coffee bean is broken into fragments via the application of pressure. It is not limited to the use of equipment known in the art as flaking rolls, but may include other types of apparatus, e.g. a press, which is capable of breaking up the coffee bean into fragments under pressure.

Gentle granulation is a term selected to denote the type of grinding to which the fragmented coffee obtained via compression flaking is subjected. Such granulation is differentiated from standard grinding used on whole roasted coffee beans in that, as compared with such standard grinding it produces less breakage of the compressed flakes obtained from the previous step.

The process of this invention is used to obtain unexepected and desirable characteristics in the final coffee product. Thus, the coffee product of this invention when prepared in a home percolator yields a brew which, surprisingly, has less sediment and a darker appearance. Also, a more consistent brew quality is obtained.

Normally, coffee which is decaffeinated prior to roasting has a different, less desirable appearance than roasted and ground coffee which has not been subjected to decaffeination. Unexpectedly, decaffeinated coffee which is roasted and treated by the process of this invention has an appearance very much like the undecaffeinated product.

Particular flavor characteristics in coffee are developed by roasting a given variety of

coffee to a specified roast color. While grinding is known to effect extraction rates, it was not expected that a process such as the process of this invention could change these particular flavor characteristics developed in roasting. Surprisingly, it has been found that the process of this invention does indeed effect the flavor characteristics, especially of better quality coffees. The target roast color should be 5 to 15 color units lighter when treating coffee via the process of this invention to obtain the same flavor characteristics in coffee processed via standard grinding techniques. (Color unit is defined in more detail later).

It is possible to achieve a much more uniform particle size and density via the process of this invention, as well as increased available soluble solids. These desirable characteristics lend themselves admirably to commercial percolation techniques and the combination of compression flaking, gentle granulation and percolation is an improved method of making a soluble coffee.

Coffee treated by the process of this invention has the additional advantage of being degassed and more compact than coffee which is subjected to standard grinding techniques. Thus, an advantage of the process of this invention is that new and more economical containers can be used than the vacuum cans used for packaging standard roasted and ground coffee.

Compression flaking can be carried out on several different types of equipment. Regardless of the equipment used it is important to control the actual pressure applied to the roasted coffee beans. This pressure should normally be between about 1500 to 13,000 p.s.i. and more preferably about 4500 to 7500 p.s.i. Standard presses such as a Stokes Tablet Press can be successfully employed in the process of this invention. After the beans have been pressed on a standard press they are subjected to shaking action on a screen wherein the pressed coffee beans tned to break up into flakes. The very large flakes or beans which have not been flaked may be separated out as overs and recycled into the pressing operation. It has been found that compacting mills such as those produced by Allis-Chalmers described in their catalogue 06B8836D or by Komarek-Greaves in their catalogue 200 are a more preferred means of achieving compression flaking. The roasted whole coffee beans are force fed between the rolls of the compacting mill and tend to come out in the form of pressed beans, which break apart into coffee flakes. Note that this use of compaction mills is somewhat different than that described as the normal purpose of a compaction mill which is to press small particles into a cake which cake is then broken into flakes having a size significantly greater than the size of the feed material. In the process of this invention whole coffee beans are being subdivided into flakes which are significantly smaller than the feed material.

When using a compacting mill, some of the coffee beans are merely flattened as they pass through the rolls, while other beans tend to be flattened and also to break into smaller pressed pieces. It has been found that to avoid excessive fines in the final product, an excessive amount of smaller pressed pieces should be avoided. Thus, it is preferred to limit the number of flakes which pass through a 40 mesh screen to a maximum of about 20% of the feed material. In order to prevent excessive fines production it is important to have the beans grabbed by the rolls and passed through in a continuous stream. It has been found that if the surface of the rolls are roughened or corrugated the desired feed is obtained and fines are kept at a minimum as compared to smooth rolls. This is particularly true where the diameter of the rolls is 20 inches or less. Larger rolls may not need a rough surface because of the greater angle of nip at the point the beans are passed between the rolls.

It has been found that the coffee flakes produced via the compression flaking operation are significantly more fragile than the whole coffee bean and must be ground via a gentle granulation technique, as opposed to the standard roll type grinders used in the coffee industry today. A preferred method of carrying out the gentle granulation is to use equipment commonly referred to as a granulator such as that produced by Colton or Stokes. The granulators have a second advantage in that the flakes are broken into small pieces which are forced through a screen. The screen size can be varied as a means of controlling the particle size of the final product. While there is no specific limitation on the screen size to be used, it has been found that coffee with desirable qualities can be prepared using standard screens that vary from 4 to 10 mesh.

Roll type grinders can probably be used as an alternate means of achieving gentle granulation, if the proper roll surface and spacing can be selected to avoid excessive breakage of the flakes during the granulation step. It would probably be more difficult to achieve the desired control of particle size using roll type equipment.

Several major changes in the physical characteristics of the coffee are attributed directly to the pressure to which the beans are subjected during the compression flaking operation. These are: an increase in density, an increase in available soluble solids which are extractable under atmospheric pressure conditions, and degassing. It has been found that the available soluble solids are increased from 8 to 40% with the greater

increases being associated with higher pressures. There is apparently a limit to the increase in available solids achieved via the application of pressure. The application of higher pressures does not significantly increase the available solids above 40%.

Pressure can be used to control the final density of the product. Surprisingly, it has been found that the size of the screen used in the gentle granulation step of the process does not have as significant an effect upon density as the pressure used in the compression flaking operation. The following table summarizes the effect of pressure on density for a wide variety of coffees processed through 4 mesh, 7 mesh and 10 mesh screens on a Colton granulator:

EFFECT OF PRESSURE ON DENSITY

Pressure (psi)	Density (g/cc)	% Increase*
6,000	0.38—0.41	10—18
9,000	0.43—0.46	25—32
12,000	0.49—0.52	38—47

*Increase is compared to standard roasted and ground coffee not treated by the process of this invention having a capacity of 0.350 g/cc.

During the compression flaking operation the coffee is degassed. It has been found that at least 800 cc. of gas per pound of coffee processed is expelled. Thus a degassed coffee is achieved via the process of this invention. Several potential advantages are associated with the degassing. First, it is not necessary to have a hold up period after grinding (normal technique in a standard coffee operation) prior to packaging. Also, the coffee can be packaged in new and novel containers which do not have to be capable of withstanding a pressure buildup in the package due to the release of gas from the coffee after packaging (even after the standard holdup period prior to packaging).

It is also a preferred embodiment of this invention that the gas expelled in the compression flaking operation can be used to maintain an inert atmosphere around the coffee from the time it enters the compression flaking equipment to the time it is packaged. Thus, if the equipment being used is shrouded, it has been found that sufficient gas is liberated to replace the air in the shroud and since additional gas is constantly being liberated, an inert atmosphere is maintained.

Several unique and unexpected changes in the physical and organoleptic qualities of the coffee are achieved via the use of compression flaking followed by gentle granulation. The quality of a beverage prepared in a home type percolator is significantly improved when using coffee which has been subjected to the process of this invention. The resultant brew is found to be more uniform. Also, the brew appears clearer and darker (or richer). Most surprisingly, although the amount of fines in the product of this invention may be equivalent to the fiines in coffee prepared via standard roasting and grinding, the amount of sediment in the resultant brew is significantly reduced when using coffee prepared by the process of this invention.

It has also been found that the appearance of coffee which has been decaffeinated prior to roasting is significantly improved via the process of this invention. Regular roasted and ground decaffeinated coffee has been described as having a shiny, regular, granular, smooth appearance as compared to undecaffeinated coffee which appears more fuzzy, more irregular and has an apparently rougher surface. Surprisingly decaffeinated coffee prepared by the process of this invention has an appearance much more similar to that of undecaffeinated coffee.

It has long been known in the art that a particular type of coffee roasted to a particular color will develop a characteristic type of flavor. It has long been felt that grinding does not significantly change the flavor associated with a particular roast color. Most unexpectedly, it has been found that coffee treated via the process of this invention (compression flaking followed by gentle granulation) does effect the flavour normally associated with a particular roast color. This flavor effect is most pronounced when treating the so called "better" coffees such as Brazils and other Milds. Indeed, it has been found that coffee subjected to the process of this invention should be roasted about 5 to 15 color units lighter than coffee ground on standard coffee grinders in order to achieve comparable flavor characteristics.

Color units as used in this application, refer to a system of color measurement which uses light reflectance as a measurement of color. The higher the number, the lighter the roast color. A Photoelectric Reflection Mill Model 610 and a Model 610Y Search Unit are used to measure light reflectance

from a ceramic plate of a specified brown color and hue. The reading thus obtained is assigned an arbitrary color rating, e.g. 50, and any new plates to be used in setting up equipment are calibrated against the original standard plate. Coffee is then placed beneath the probe of the unit (a preselected screen fraction of ground coffee is used for this purpose) and the difference in reflected light between the calibration plate and the coffee is indicated as color units on the instrument. When a light coffee (as compared to the standard plate) is placed beneath the unit, the light reflectance is greater and the needle moves up scale to a higher reading. It is this type of color measurement that is referred to in describing the difference in color needed to achieve an equivalent flavor type. It is to be noted that when using this type of color measuring equipment a difference of four color units on the meter is readily detected by eye.

The process of this invention can be used to prepare roasted coffee for treatment in commercial percolators in a soluble coffee system. The more uniform particle size, density control over the particles and increased available soluble solids can be effectively utilized in extraction of roasted coffee. One potential advantage is the ability to obtain an extract having a greater solids content then that attained when using standard roasted and ground coffee.

A particular advantage of the process of this invention is the ability to achieve different flavor characteristics of soluble and regular coffees by using unique combinations of roast color and compression flaking followed by gentle granulation.

The process of this invention will be further explained by reference to the following examples:

EXAMPLE I

A blend of green coffee containing 60% Milds and 40% Robustas was roasted to a 65 roast color. The coffee was then divided into three parts. One part, the control sample, was processed on a standard Gump grinder. One part was subjected to compression flaking in a Stokes Model No. 294 Press at a pressure of 7,000 psig. The pressed coffee was passed over a screen and the resultant flakes were passed through a Colton granulator containing a 10 mesh screen. The third fraction was pressed at 16,000 psig and then passed over a screen and into the Colton granulator. The samples were prepared such that the flaked and granulated product of this invention had a coarse particle distribution, so that the resultant brews prepared in a home percolator would have about the same soluble solids content as the control (fraction 1 subjected to standard grinding). The following table summarizes the particle distribution density and brew solids of the three fractions:

SCREEN ANALYSIS

Mesh	7,000 psig	16,000 psig	Control
12	23.1%	21.2%	1.0%
16	44.5	45.0	14.0
20	18.6	20.8	43.0
30	5.5	5.6	24.0
40	3.2	3.2	10.0
Pan	5.0	4.0	8.0
Density	0.36 gm/cc	0.40 gm/cc	0.30 gm/cc
Brew Solids	1.31%	1.26%	1.25%

It was observed that the brew prepared from the fractions subjected to the process of this invention were less turbid, darker, and contained less sediment. There was a difference in flavor type noted between the control brew and the brews prepared via the inventive process.

EXAMPLE II

The process of Example I was repeated with the following exception: $\frac{2}{3}$ of the blended green coffee were roasted to a 73 roast color (8 color units lighter), while $\frac{1}{3}$ of the green coffee was roasted to a 65 roast color. The 65 roast color fraction was used as a control and subjected to standard grinding techniqunes. The 73 roast color material was divided into two fractions which were subjected to pressures of 7,000 to 16,000 psig in the Stokes Press and further treated as in Example I. It was observed that the brews prepared from all of the samples were described as having the same flavor type. The physical differences between the brews prepared from the control and the samples processed via the process of this invention were again observed.

EXAMPLE III

Example I was repeated, but in place of the Stokes press a Komarek-Greaves Compaction Mill was used.

The roll diameter was 20 inches and the surface of the rolls were roughened to insure

proper feed of coffee beans through the rolls. A pressure of about 1200 lbs. was used and coffee was pass through the unit at a rate of about 4500 lbs./hr. The differences observed in Example I were again observed in the brews prepared in this example.

The width of the rolls used for this experiment was 13 inches and the pressure applied was equivalent to slightly less than 100 lbs. per linear inch. When using compression rolls the pressure rather than being expressed as lbs. per square inch (as when using a press) is commonly expresed as lbs. per linear inch. It has been found that the pressure applied to compression rolls may vary from 50 to 300 lbs. per linear inch when practicing the process of this invention, and a preferred range is from 50 to 500 lbs. per linear inch Note, that this is an unusually low range for compaction mills which are designed to run a pressure from 12,000 to about 25,000 lbs. per linear inch when they are being used to compact granular materials into a cake form.

The foregoing examples were for illustrative purposes only and the invention is intended to be limited only by the appended claims.

WHAT WE CLAIM IS:—

1. A process for producing a coffee product in which roasted coffee beans are compression flaked and the fragmented coffee beans are gently granulated.

2. A process according to claim 1, in which the roasted coffee beans are subjected to a pressure of from 1,500 to 13,000 psi during the compression flaking operation.

3. A process according to claim 2, in which the roasted coffee beans are subjected to a pressure of from 4,500 to 7,500 psi during the compression flaking operation.

4. A process according to any one of claims 1 to 3, in which compaction rolls are used in the compression flaking operation and wherein a pressure of from 50 to 500 lbs. per linear inch is applied.

5. A process according to claim 4, in which the pressure is from 50 to 300 lbs. per linear inch.

6. A process according to any one of claims 1 to 5, in which the fragmented coffee beans are passed through a granulator having from a 7 to 16 mesh U.S. Standard screen.

7. A process according to any one of claims 1 to 6, in which the compression flaking and gentle granulation are performed in an enclosed system, the gases expelled from the coffee beans being permitted to replace the air in said enclosure, said gases having a volume of at least 800 cubic centimeters per pound of roasted coffee processed, thus protecting the coffee being processed from exposure to oxygen.

8. A process according to any one of claims 1 to 7, in which the green coffee is roasted from 5 to 15 color units lighter than coffee ground via standard grinding techniques.

9. A process of producing a coffee product according to any one of the preceding claims and substantially as hereinbefore described in the individual specific embodiments with particular reference to the Examples.

10. A coffee product when produced by the process of any one of claims 1 to 9.

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